User manual

HRD SYSTEM AND BARRIER WITH LOCK

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CONTENTS

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1. INTRODUCTION - GENERAL

This documentation is used as instructions for customers and concerns the HRD system and HRD barrier technology. It will let a customer or user (further in text called a customer) to become familiar with basic principles of HRD systems and descriptions of individual used components, and it also includes basic terminology.

It includes the description of the system operation for a customer, as well as maintenance and service instructions. It also contains prohibited functions and activities that may never be performed by operators. The documentation is handed over to a customer together with an HRD system and a barrier, and serves as instruction documentation, while the HRD system and barrier are handed over to the customer.

A customer should study and become familiar with this documentation and all other written documents supplied to him, and introduce them to his employees with appropriate qualifications (electrical, machinery, technology, and safety technicians), and also to other subjects of external companies that come into contact with HRD technological systems and barriers at the customer. Certain parts from the operation and maintenance chapters should be included in the customer's operational regulations, maintenance schedules etc. In case of any doubt please contact RSBP or its authorized representative.

The customers should pay increased attention to the chapter that is related to safety, since the HRD system and HRD barrier are pieces of equipment that can be dangerous if operated or maintained improperly, and can cause technological damages and defects, as well as accidents and injuries with permanent results or death.

2. TERMINOLOGY

a) An HRD (High Rate Discharge) technological system is a system that automatically detects occurrence of explosion and consequently is able to prevent or suppress it. It consists of detectors, control units, and active elements, and possibly other technical accessories. The whole explosion suppression is over in milliseconds. HRD systems are generally divided to explosion suppression HRD systems and HRD barriers to prevent explosion propagation.

b) Explosion suppression HRD system is a technological system that detects explosion occurrence and consequently is able to suppress it by quick introduction of extinguishing medium to the protected area. Explosion pressure inside of protected equipment is thus limited to the value that is less than the pressure resistance of the equipment, and therefore the equipment is not destroyed. Typical protected objects are storage tanks, silos, mills, etc.

c) An HRD barrier - is a technological system that prevents propagation of explosion, it detects explosion occurrence and consequently, by introducing extinguishing medium to the protected object, it is able to prevent transfer of a flame front to the following technology equipment. Typical protected objects are conveyors, pipelines etc.

d) A detector – is a sensor or switch (pressure or optical) that monitors and detects occurrence of explosion and passes this information to a control unit.

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e) A control unit – is a device that evaluates information from detectors that monitor and detect explosion occurrences, and consequently sends impulses to active elements (pressure generators) to suppress these explosions. It also manages the whole system, including the analysis of possible defects, and provides an interface for customers, and possibly communication for superior management systems.

f) An action element (pressure generator) – is a device that, based on an electric impulse from a control unit, will suppress an explosion or prevent transfer of a flame front to the following technologies. Technologically a pressure generator is a part of an HRD vessel.

g) An HRD vessel – is a pressure vessel with accessories that is used to store and apply extinguishing medium for the purpose of explosion suppression or prevention of flame front transfer to the following technologies.

h) Extinguishing medium – is the medium stored in the complete HRD vessel system that is used to suppress an explosion or prevent flame front transfer to the following technologies.

3. HRD SYSTEM AND BARRIER DIAGRAMS

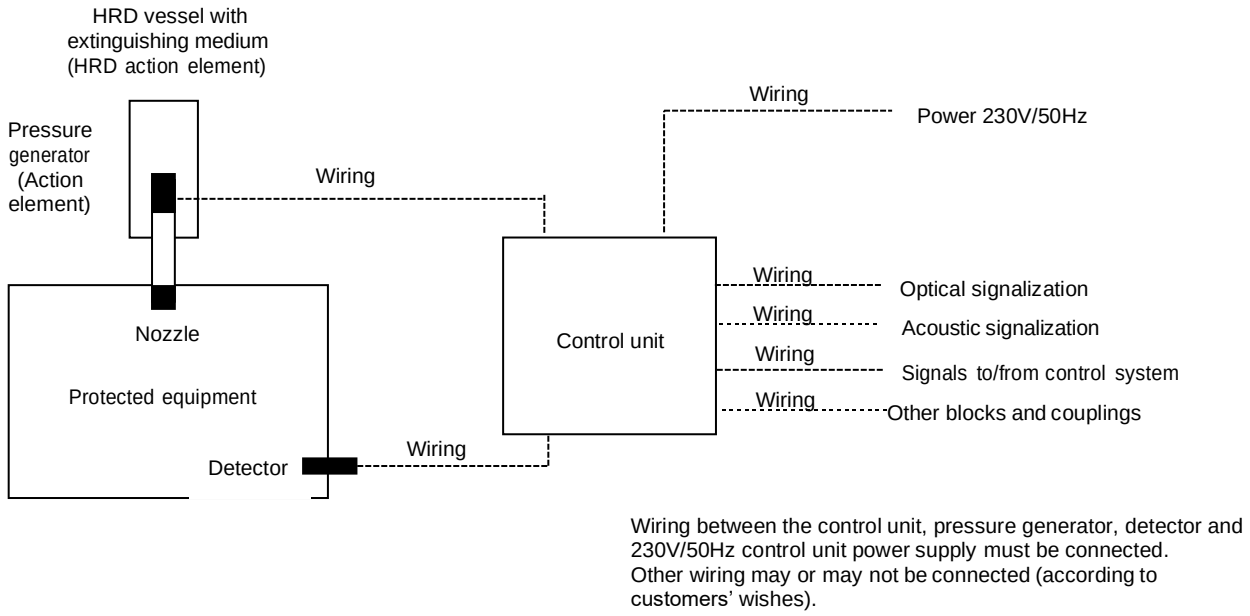

Figure no. 1 – Block diagram of the protection by HRD system and barrier

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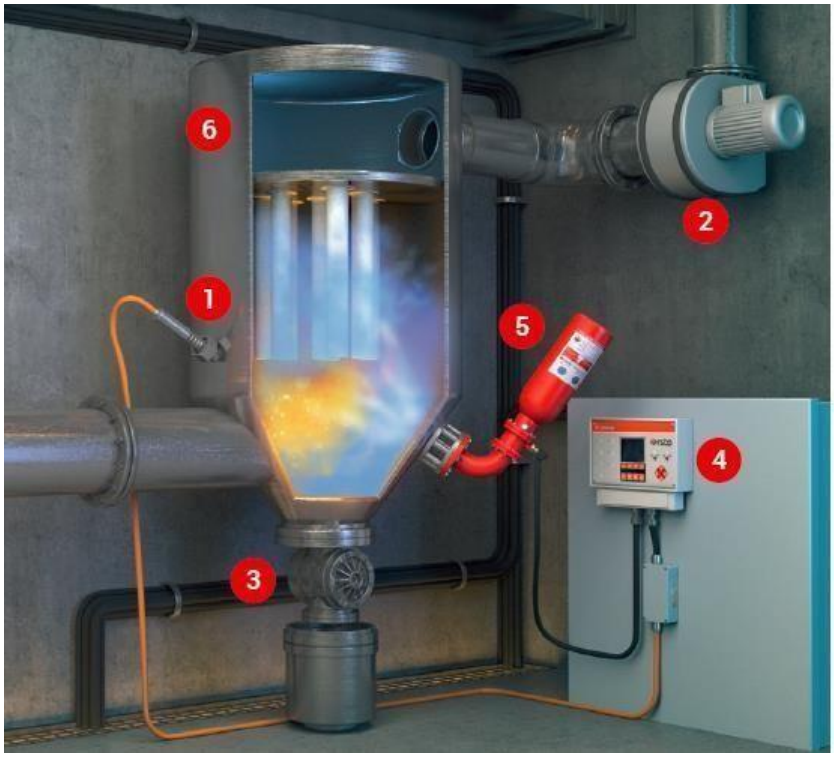
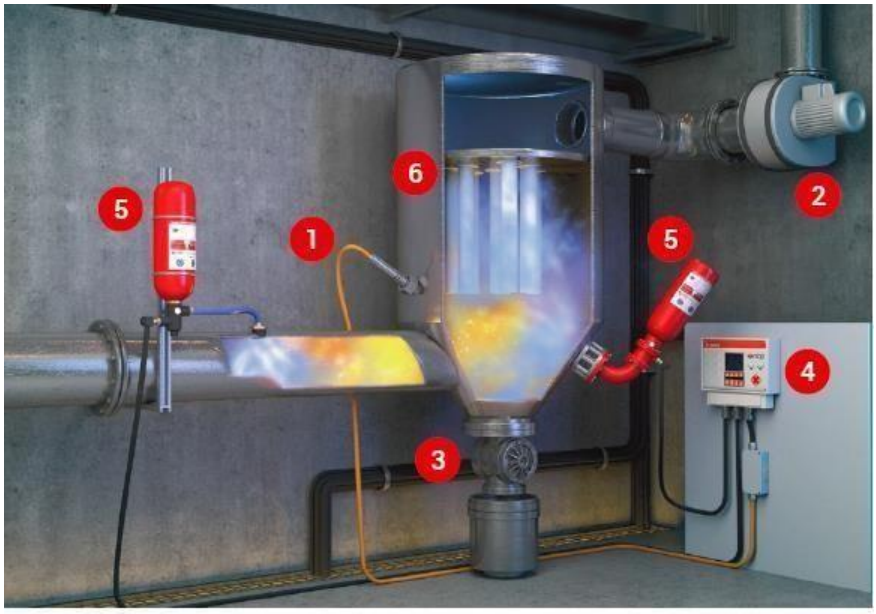


1. Explosion detector
2. Fan
3. Rotary valve
4. Control unit
5. HRD container unit
6. Filter

Figure No. 2 - Schematic diagram of the HRD system



1. Explosion detector
2. Fan
3. Rotary valve
4. Control unit
5. HRD container unit
6. Filter

Figure No. 3 - Schematic diagram of the HRD system and HRD barrier

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4. THE PRINCIPLE OF HRD SYSTEM AND HRD BARRIER FUNCTION

A protected device is equipped by an HRD system or an HRD barrier according to the figures in Chapter 3. During operation status with the pressure level not indicating explosion occurrence within the protected device (silo, conveyor, mill, pipeline, etc.) the HRD system is inactive, but prepared to immediate explosion suppression.

Its detector continuously monitors and detects the occurrence of explosion in the protected equipment, and passes the information to the control unit. Explosion detection can be based on pressure or optical measurement (pressure changes and changes of light spectrum levels) - attributes that accompany the occurrence of explosion.

The control unit continuously analyses information from the detector that monitors and detects explosion occurrence in the protected equipment, and consequently sends an impulse to an action element. Beyond this function the control unit is capable to signal function states remotely (optically or acoustically) if needed, process input and output signals to/from a superior control system, or perform other blocs and couplings.

An action element (pressure generator) is a technological part of an HRD vessel that, based on the impulse from a control unit, suppresses an explosion, because by its action the HRD vessel valve opens, and extinguishing medium is quickly introduced to the protected equipment.

5. DETECTORS

A detector – is a sensor or switch that continuously monitors and detects occurrence of explosion in the protected equipment and passes this information to a control unit. Explosion detection can be based on pressure or optical measurement (pressure changes and changes of light spectrum levels) - attributes that accompany the occurrence of explosion.

Figure No. 4 – Detectors used for the detection of explosion (from the left DETEX, LUMEX 1, LUMEX 3)

A detector is installed to the protected equipment using a installation adapter. It is connected to a control unit by wiring that carries information about its status, and also the detector is powered through it. Specific wiring and the diagram are shown in the electrical documentation that is supplied to a customer.

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There are pressure and optical attributes during the explosion in the protected equipment that are detected and measured by pressure or optical detectors that measure pressure changes or changes of light spectrum level. The detector transforms these physical quantities to electrical ones, and after exceeding the set limit of the measured quantity there is a change in resistance in the control unit detection line, and that is evaluated as an alarm.

The pressure detector DETEX, and the optical infrared detectors LUMEX 1 and LUMEX 3 are used in the HRD system or barrier applications.

These detectors are described in their separate Operation Manuals as far as their installation, maintenance, service and operation are concerned. These manuals are supplied to customers as well.

6. CONTROL UNIT

A control unit – is a device that evaluates information from detectors that monitor and detect explosion occurrences, and consequently sends impulses to active elements (pressure generators) to suppress or prevent transfer of these explosions.

A control unit is installed near the protected equipment in the reach of operators and outside of explosion danger zones. The detection line (detector) and activation line (action element) wiring is brought to a control unit, the unit is powered by line voltage, and optical or acoustic signalization, signals to/from the control system and other blocks and couplings can be connected here as well.

Figure No. 5 - The CONEX control unit

The CONEX control units (in two, four, six, or eight-zone versions) are used in HRD system and HRD barrier applications.

These control units are described in their separate Operation Manuals as far as their installation, maintenance, service and operation are concerned. These manuals are supplied to customers as well.

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7. PRESSURE GENERATOR

A pressure generator (action element) is a device that, based on the impulse from a control unit, suppresses an explosion. Technologically a pressure generator is a part of an HRD vessel.

A control unit, based on information from detector that monitor and detect explosion occurrence, sends an electric impulse to a pressure generator, here an electrical impulse fires off a powder charge, which creates a mechanical impulse that mechanically releases a discharge mechanism of the HRD valve. This enables the flow of extinguishing medium that is carried by pressurized gas through the valve from the pressure vessel for the purpose of prevention or suppression of an explosion in the protected equipment.

8. HRD VESSEL WITH EXTINGUISHING MEDIUM

An HRD vessel is a pressure vessel with accessories that is used for storing and application of extinguishing medium for the purpose of prevention or suppression of explosion. A complete HRD vessel set consists of the pressure vessel, spacer, HRD valve with a pressure generator, protective cover (safety flange), pressure gauge, electric connection box, and extinguishing medium. During origination and detection of explosion the pressure generator is initialized and fired off, this releases a safety element, and the valve opening opens. This enables a flow of extinguishing medium that is carried by pressurized gas through the valve from the pressure vessel for the purpose of prevention or suppression of explosion in the protected equipment. Also a version of HRD vessel that is equipped by an electric contact working pressure sensor and an electric induction sensor to indicate locked position of the mechanical blocking system can be supplied.

The pressure vessel is made of steel and has domed bottom that meets the requirements for metal pressure vessels intended for transport of gases. The vessel is ended by a thread that connects the spacer that connects the pressure vessel with the HRD valve.

The HRD valve in its resting state serves to keep working pressure in the pressure vessel. It is designed in such way that, after electrical impulse to open it, the pressure generator is fired off and initialized, then it releases the safety element, and this opens the valve mouth. This enables flowing of extinguishing medium through the valve from the pressure vessel.

A pressure gauge is a measuring device that shows pressure inside the pressure vessel, and is installed on the spacer. The Operator is obliged to check the HRD vessel pressure periodically by reading it off the pressure gauge. The working pressure needs to be compared with the pressure values in Table 1. The electrical connection box is used to connect cables between the control unit and the pressure generator. The protective cover (safety flange) is used to protect the HRD valve during transport, manipulation, etc.

Extinguishing medium is the extinguishing agent stored in the complete HRD vessel assembly that is used to prevent or suppress an explosion. A fine ABC extinguishing powder is used under the commercial names of FUREX 770, SODA BICARBONA, TROPOLAR FORTE, etc.

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Figure no. 6 - HRD vessels

Bottle type	A1	A2	B	C	D	E	G
Volume [l]	5.34	5.34	8	20	20	50	50
Working pressure [bar]	120	120	50	50	50	50	50
Valve size	3/4"	3/4"	3"	3"	4"	3"	4"

Table No. 1

9. LOCKING OF HRD BOTTLES – 5L

Figure 7 shows the OSHA mechanical blocking valve for HRD cylinders of 5 L. The opening / closing status of this valve is monitored by the CONEX control panel. More information is contained in the manual of this locking mechanism.

IT IS IMPORTANT FOR THE MECHANICAL LOCK VALVE TO BE FULLY OPEN OR FULLY CLOSED.

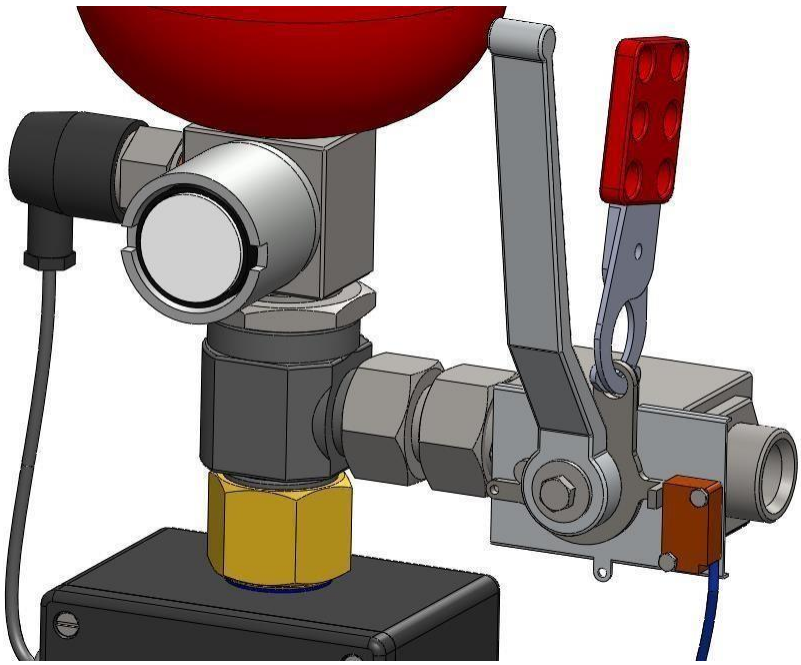

Figure no.8 –HRD bottle 5 L with OSHA mechanical blocking valve

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10. LOCKING OF HRD BOTTLES – 8l, 20l, 50l

For arresting HRD bottles 8l, 20l and 50l is used so-called locking pin. The mechanical locking pin is shown in Figure 8. This locking pin is inserted into the hole behind the box and screwed in with a wrench no 14. Tightening the locking key to the end stops the position sensor on the other side of the hole. The position switch indicates that the HRD bottle is in lock mode. The locking pin can be locked with so-called lock pliers (see Fig. 8).

It is used eg in cases of outage of HRD system (service etc.). They are used to block the system from accidentally starting and opening the bottle of extinguishing agent.

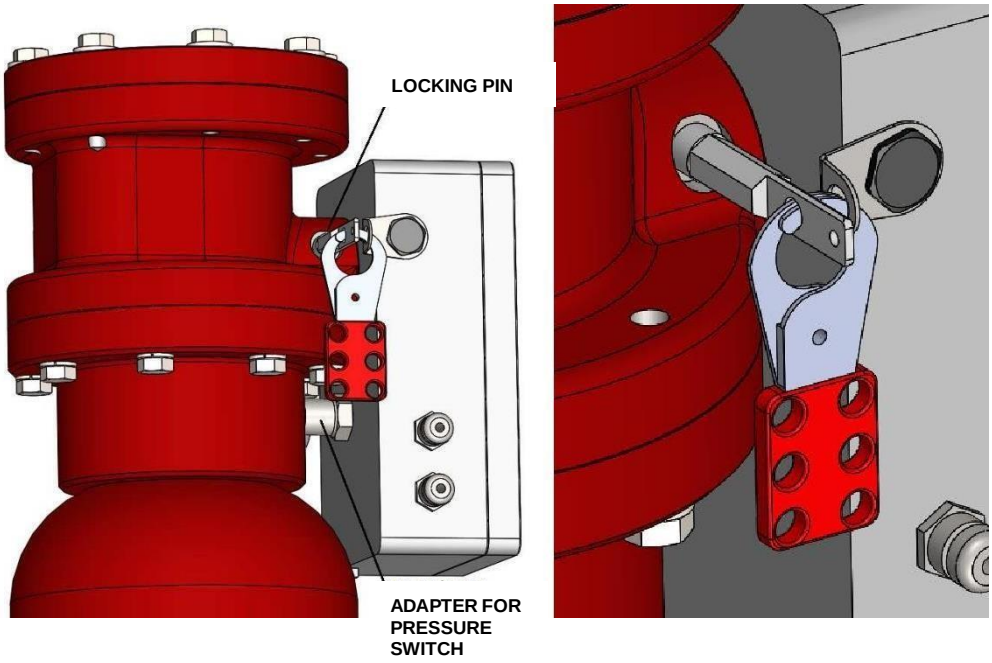

Figure no.8 – Locking pin for HRD bottle

When the bottle is in the operating state, the so-called blanking of lock pin is used (fig. 9). This plug has a signaling function (yellow color) and closes the hole for the locking pin to prevent clogging.

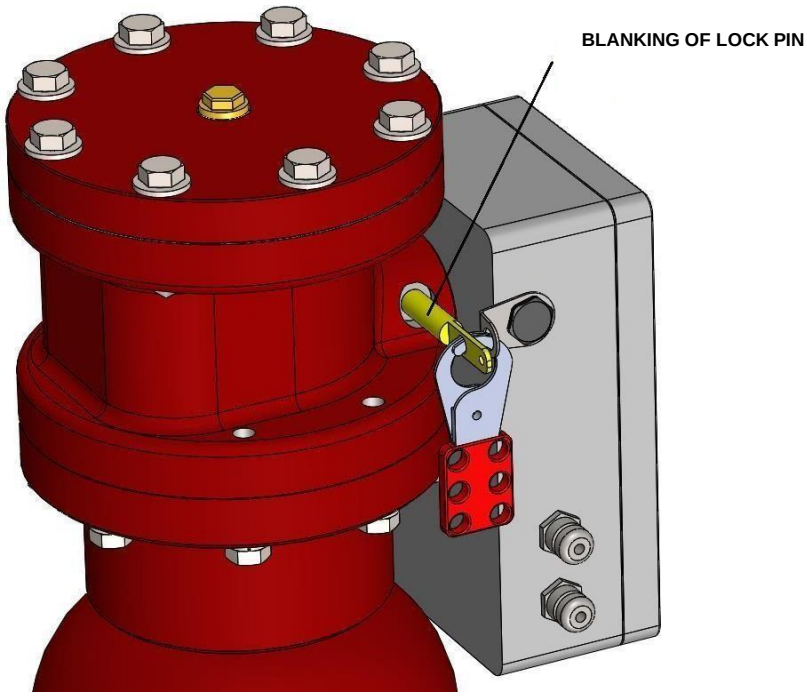

Figure no.9 – Blanking of lock pin

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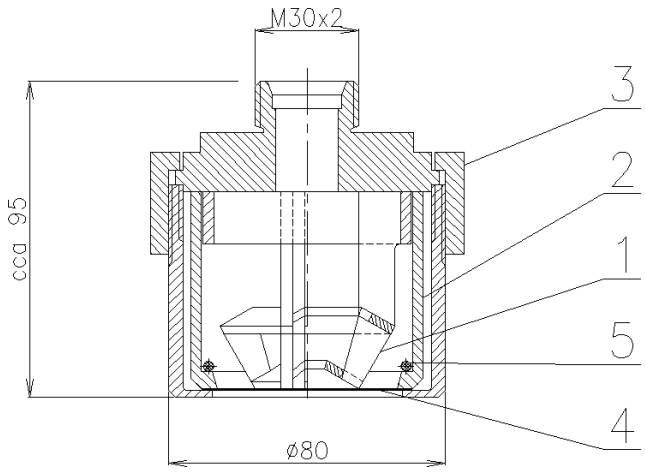
11. MANOMETER AND PRESSURE SENSOR

HRD cylinders are supplied with a pressure gauge and pressure sensor which is monitored by the CONEX control panel.

12. OTHER HRD SYSTEM AND HRD BARRIER ELEMENTS

HRD system are also includes other mechanical components for the application of extinguishing medium (nozzles, hoses, elbows, etc.), construction, attachment and installation elements used to attach HRD bottles, and detectors, bolts, washers, gaskets, etc.

Special nozzles are used to introduce extinguishing medium to the protected equipment properly. HRD systems for explosion suppression use spherical and disc nozzles that spread the extinguishing medium in the conical shape. HRD barriers for prevention of explosion transfer use fan nozzles that spread the extinguishing medium in the shape of flat curtain (so called fan).



Legend:
1 – Nozzle
2 – Nozzle guide
3 – Nut
4 – Membrane
5 – O-Ring

Figure No. 10 – DN 50 disc nozzle

There is a straight piece or elbow installed between the HRD vessel with extinguishing medium and a nozzle that can also be equipped by a flange for attachment of the HRD vessel with extinguishing medium on one side, while on the other side the nozzle is installed. Small vessels are attached only to the attachment clamps on the protected equipment construction; the application of extinguishing medium from the HRD vessel to the nozzle is through HRD hoses.

13. INSTALLATION ON THE PROTECTED EQUIPMENT

Appropriate detectors (optical and pressure), and HRD vessels with extinguishing medium (active members) with accessories are mechanically installed onto the protected equipment. The installation is performed using installation adapters, clamps, holders, flanges, etc. (see the chapter with machinery drawings in the appropriate order documentation).

The appropriate components are connected by electrical wiring after the mechanical installation, are set, their parameterization is performed, and the system is brought to operational status, and is handed over to the customer, including the initial instruction (see the chapter Electrical Part in the appropriate order documentation).

All work related to commissioning, assembly, disassembly, installation and adjusting of the HRD system and HRD barrier is done exclusively by RSBP or its authorized representative.

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14. MAINTENANCE

The HRD system and HRD barrier maintenance that is done by a customer lies only in optical and visual checks of cleanliness, mechanical damage and integrity of all technological system components. In case of any damage or failure of the above mentioned components RSBP or its authorized representative must be contacted.

Customers can perform the maintenance on pressure air supply for blow-off of optical detectors (if applicable) in regular monthly intervals.

Customers must check the working pressure on HRD vessel pressure gauges in regular monthly intervals (see Table no. 1) to see, whether the values did not go down under 35 bar for the nominal working pressure of 50 bar, or under the value of 90 bar for the nominal working pressure of 120 bar. If the actual working pressure goes under these values, RSBP or its authorized representative needs to be contacted. An HRD system or barrier may not work properly in such cases due to possible working pressure leak in the HRD vessel.

The above specified activities that must be performed by customers need to be included in the maintenance operational regulations, and the appropriate customer workers or other subjects that perform the maintenance need to be familiarized with them.

15. OPERATION

Detectors that are connected to an HRD system or barriers for suppression or prevention of fire or explosion can work automatically and without human intervention. Operators cannot and are not authorized to change detector parameters set by RSBP or its authorized representative. A separate detector service is not performed; the detectors are included in a complete superior system.

A control unit that is connected to an HRD system or barriers for suppression or prevention of fire or explosion can work automatically and without human intervention. Operators cannot and are not authorized to change control unit parameters set by RSBP or its authorized representative.

Operators can place appropriate zones or the whole control unit to the service mode and back to the operational mode, monitor control unit function states, control unit fault states, display control unit records, service intervals, actually measured values, etc. All these operational regimes and procedures for operators are completely described on the Operation Manual concerning the CONEX control unit.

A graphical LCD display, LED diodes, user buttons on the display and turn switches with keys are used for communication of operators with a control unit. All these components are located on the aluminum panel under the hinged front control unit cover. Operators can open the front cover and operate the appropriate components as needed. LCD display and LED diodes are visible and readable through the closed front cover.

All operator interventions to the HRD system and barriers should be demonstrably recorded to the technological system Book of Operations, including dates, names, and operator signatures.

Operators must be demonstrably instructed in the HRD system and barrier operation by RSBP or its authorized representative. Uninstructed personnel are expressly prohibited to operate the HRD system and HRD barrier.

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16. SAFETY

The HRD system and HRD barrier are pieces of equipment that can be dangerous if operated or maintained improperly, and can cause technological damages and defects, as well as accidents and injuries with permanent consequences or death. Especially there are dangers of injuries caused by electric current, explosion and its accompanying effects (increased pressure and temperature) and explosion consequences (flying parts of the protected equipment or the HRD system and HRD barrier). These dangers need to be eliminated to zero.

The HRD system and HRD barrier can be operated or maintained only by persons that were demonstrably instructed for these activities. These persons must be physically and psychically capable to perform these activities, and may not be under influence of alcohol or drugs.

There are so called forbidden and also mandatory activities that customer workers (and also other subjects) may not, or on the other hand, must perform in relation to the HRD system or HRD barriers. In case that they are performed, or on the other hand, not performed (as the case may be), RSBP or its authorized representative does not provide a warranty to the customer, and RSBP or its authorized representative is not liable for any material or legal damages. Customer workers (and also other subjects) must be in this regard demonstrably instructed by the customer about the above or below mentioned safety principles, and they have to adhere to them.

<u>The prohibited activities are:</u>

- It is forbidden to stay in areas protected by HRD systems or barriers, while they are under operation.
- If detectors that work on the pressure sensing principle are used, their exposure to continuous (operational) or random (for example during cleaning, maintenance, removal of vaulted stuck-together material by hammer etc.) mechanical shocks must be prevented. These shocks could cause false explosion detection and reaction of the HRD system or barrier.
- If detectors that work on the light sensing principle are used, their exposure to other light effects than to the fire induces ones (like the ones during welding and intrusion of artificial or natural light) must be prevented. These undesirable light effects could cause false explosion detection and reaction of the HRD system or barrier.
- Any unauthorized interventions to the HRD system or barrier (its mechanical and electrical parts) are prohibited.
- It is prohibited to break or otherwise damage the HRD system or barrier (its mechanical and electrical parts).
- It is prohibited to break the seals, and change settings and parameters of the HRD system or barrier.
- It is prohibited to operate the incomplete or damaged HRD system or barrier.
- It is prohibited to remove safety covers, barriers etc. for no reason.

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The mandatory activities are:

- It is forbidden to stay in areas protected by HRD systems or barriers, while they are in “operational mode” (this restriction is valid for operators, other customer workers, and also for other subjects). If people need to stay in these areas and perform cleaning, mechanical work, repairs, etc., then it is necessary to place the appropriate technological sections (zones) to the “service regime”, which is done by operators using the control unit. This procedure is completely described in the Operation Manual for the CONEX control unit.
- A customer must provide the main power supply for the CONEX control unit with the voltage with prescribed parameters.
- A customer must provide pressure air for blow-off of optical detectors.
- When the HRD system or barrier activation is signaled, people need to proceeded according to the customer fire plan. The fire plan can set the exact procedures for the operators during reporting of the control unit defect or activation of the HRD system or barrier.

In case of any doubts concerning prohibited and mandatory activities please contact RSBP or its authorized representative.

17. ELECTRICAL INSPECTIONS OF HRD SYSTEM AND BARRIER, HRD SYSTEM AND BARRIER SERVICE

The initial electrical inspection is provided by RSBP or by its authorized representative. The following regular electric inspections in regular intervals from the initial inspection can also be performed by RSBP or its authorized representative or they can be performed by a customer.

In case that these electrical inspections are provided by a customer, then this work must be done only by persons with appropriate electrotechnical qualifications, and it is absolutely necessary that a RSBP or its authorized representative employee is present during each inspection (initial or periodical), as the expert assistant and guarantor of the correct function of the HRD system or barrier.

Regular HRD system and barrier service is performed exclusively by RSBP or its authorized representative in untermentioned intervals. Customers or any other entities cannot perform any control unit service.

Intervals of regular services:

1 x per 6 months	checking of HRD system and/or HRD barrier (control units, detectors, HRD vessels)
1 x per 1 year	checking HRD vessels, nozzles, extinguishing medium and its distribution, pipes, tubes
1 x per 3 years	change of internal accumulator in control units (batteries), change HRD activator
1 x per 10 years	pressure test of HRD vessels according to the valid legislative